1. **Writing Reports for Chemistry 231**

There are 4 sections to each lab report. Reports that do not follow this format will be graded harshly. Organize the four sections of your report in this sequence:

# I. Introduction

Use correct English, correct spelling, grammar and complete sentences. Use paragraphs! Each new topic sentence is the beginning of a new paragraph.

Introduce the experiment. The first paragraph should state the objective of the experiment. An example for a technique experiment could be:

*“The objective of this experiment is to learn about gas chromatography and use the GC instrument to analyze a mixture of alcohols. The goal is to obtain the mole percent of each component in the mixture.”*

An example for a prep experiment could be introduced in a general fashion:

*“This experiment will investigate the esterification of acetic acid with an unknown alcohol. The crude product will be analyzed by GC to determine the amount of unreacted starting materials. The crude product will be purified by distillation and the product will be identified using proton NMR and IR..”*

Describe the method. The second paragraph should explain how to perform the experiment. For a technique experiment, a description of the technique should be included. Most likely, you will have to describe the theory behind the technique and explain the general operation of equipment or instrumentation. You may include some details of the procedure but, do not simply copy or paraphrase the experimental procedure from your text. For prep experiments, the name of the organic reaction and a written reaction should be included. Often you will need to draw the mechanism of reaction as well to help elucidate the objective and clarify your written description.

Bear in mind that all of the lab techniques are based on some physical property. Regardless of whether you are doing a technique or a prep experiment, be sure to mention the physical property that is exploited to achieve separation, purification or identification of your analytes.

Provide as much theory and background as necessary so that the reader can understand why the method you chose will allow you to achieve your objective.

**II. D & O (data and observations)**

This section of the report will be the carbon copy pages from your laboratory notebook, attached in the report directly after the Introduction. You report grade depends on whether or not I can read the carbon copies; make it so! I expect each page to be dated and headers complete.

All data should be recorded in your notebook. Complete sentences are not required but exact language is important. This is what I look for in D & O pages:

Each data entry must have a description such as:

*1.995 g mass of ketone*

*O.865 g mass NaBH4*

*20 mL of EtOH*

As you follow your procedure, you should record observations such as:

* *… addition of solvent gave a cloudy mixture …*
* *… reaction flask slightly warm after addition of reducing agent …*
* *… no color change observed after 5 minutes …*
* *… gas evolution began when reaction was heated …*

Your experimental results must be in the notebook. This includes your calculations for percent yield, percent purity, melting points, masses, volumes, etc.

Annotation of spectra or results from chromatograms or chart recorders is essential. Every spectrum (IR, NMR) and every GC chromatogram must be crossed-referenced to the actual spectrum and the corresponding page in your notebook. The easy way to do this is to write a reference number on your spectrum, for example, IR-24.1. On page 24 of your notebook you have commented, *“IR spectrum of product obtained [IR-24.1”]*. If you obtain a second spectrum of perhaps a by-product, label it as [IR-24.2] and write its description on page 24 as well. Spectra described on page 25 would be numbered 25.1, 25.2, etc.

If you have followed the reaction with thin-layer chromatography, the TLC plates can be traced and then hand-drawn in ink to represent the spots on the actual plates. Here it is important to make note of the size and color and darkness of the spots on your TLC plates.

# III. Results

Use correct English, spelling and complete sentences. Avoid trivial expressions or ambiguous statements. Report the results of your experiment clearly and concisely. The easy way to write your Results section is to think back to the objective and present your results as the answer to your goal which you stated in the Introduction.

You may include a Table of Results if appropriate but be sure to identify results that are contained in Tables, Charts or Graphs. In other words, be sure to explain the main entries in each Table or Chart; presenting your results as nothing more than a Table without any description is not acceptable.

Whenever you report a percent yield, be sure to explain how the yield is calculated and step through at least one example of each type of calculation. For example:

*“The percent yield for the esterification of acetic acid was 78.2 % based on the mass of crude product. After purification, the percent yield was 64%. Percent yields are based on the mass of limiting reactant (acetic acid) and mass of ester; the stoichiometry of acid to ester is one-to-one.”*

--- show sample calculation here (handwritten OK) ---

When you present results from various analyses such as NMR, IR, GC, etc., be sure to refer to the reference number. Furthermore, avoid useless statements such as *“the IR spectrum showed there was an ester”*. A better presentation would be:

*“The IR spectrum of the product was consistent with the structure of an ester and contained the diagnostic signals for a carbonyl stretch and the ether oxygen C-O vibration.” The table below lists the major signals for the IR spectrum.”*

Table of IR Frequencies for Pure Product Ester

*2930 cm-1 C-H vibrations*

*1745 cm-1 carbonyl stretch*

*1285 cm-1 C-O ether oxygen group*

# IV. Discussion

Use correct English, spelling and complete sentences. Discuss your results. A good way to write this section is to restate the hypothesis or your objective, then summarize the main results that support or refute your hypothesis. This should lead to your conclusion(s).

**Lab reports are graded using the following criteria:**

points

10       Format correct

20       Introduction

            \_\_\_Statement of problem or investigation

            \_\_\_Method

            \_\_\_Chemical equations / structures

20       D&O

            \_\_\_Entries in notebook / ink

\_\_\_Headers; dates

            \_\_\_Table of Reactants and Products

            \_\_\_Observations  (mass, vol, temp, time)

            \_\_\_Sufficient annotation for data

            \_\_\_Proper corrections, deletions

20       Results

            \_\_\_Main results clearly presented

            \_\_\_Explanation of Tables/Graphs

            \_\_\_Calculations correct

20   Discussion

            \_\_\_Main results interpreted

            \_\_\_Conclusions

10       Exercises